

We claim:

1. A multicast optimization method in a cross-VLAN switching device operatively coupled to one or more multicast group members configured in a plurality of VLANs and to one or more nodes via a VLAN-tagged communications link; the method comprising the steps of:
  - (a) receiving a multicast stream within a first VLAN of the plurality of VLANs; and
  - (b) internally distributing the multicast stream toward substantially all the multicast group members registered at the cross-VLAN switching device to receive the multicast stream;wherein a single copy of the one or more multicast streams propagates across said one or more VLAN-tagged communications links.
2. The multicast optimization method in claim 1, wherein the step of internally distributing the multicast stream to substantially all the multicast group members comprises the steps of:
  - (a) internally routing the multicast stream from the first VLAN to each VLAN in which there is a multicast group member registered to receive the multicast stream; and
  - (b) switching the multicast stream from each VLAN in which it is present in a cross-VLAN switching device towards substantially all of the multicast group member registered to receive the multicast stream.
3. The multicast optimization method in claim 2, wherein the step of routing the multicast stream comprises the step of decrementing the time-to-live counter of the packets of the multicast stream.
4. The multicast optimization method in claim 1, wherein the method further includes the step of registering the one or more multicast group members at the cross-VLAN switching device, each registration constituting a subscription to the multicast stream.

5. The multicast optimization method in claim 4, wherein the step of registering the one or more multicast group members at the cross-VLAN switching device comprises the step of recording multicast group members subscriptions in one or more  
5 VLAN/multicast group membership tables.
6. The multicast optimization method in claim 5, wherein the one or more  
VLAN/multicast group membership tables of the cross-VLAN switching device  
associate a multicast address and an IP address of the one or more multicast group  
10 members.
7. The multicast optimization method in claim 4, wherein the method further includes  
the step of receiving, prior to the step of registering, a multicast declaration message  
from a plurality of said one or more multicast group members.  
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8. The multicast optimization method in claim 7, wherein the multicast declaration  
message from the plurality of said multicast group members is an IGMP Membership  
Report message.
- 20 9. The multicast optimization method in claim 7, wherein the method further includes  
the step of forwarding only the first multicast declaration message of the plurality of  
multicast declaration messages upstream towards a root router.
10. The multicast optimization method in claim 4, wherein the method further includes  
25 the step of de-registering a multicast group member at the cross-VLAN switching  
device, each de-registration constituting a rescission of the subscription to an  
associated multicast stream.
11. The multicast optimization method in claim 10, wherein the method further comprises  
30 the step of receiving, prior to de-registering a multicast group member, a leave

message from a plurality of the one or more multicast group members to rescind the subscription to the associated multicast stream.

12. The multicast optimization method in claim 11, wherein the leave message is an  
5 IGMP Leave message.

13. The multicast optimization method in claim 11, wherein the method further comprises  
the step of forwarding only the last leave message of the plurality of leave messages  
towards an upstream router.

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14. The multicast optimization method in claim 13, wherein the last leave message of the  
plurality of leave messages includes a VLAN identification of the first VLAN.

15 15. A multicast optimization method in a cross-VLAN switching devices operatively  
coupled to one or more multicast group members associated with at least one of a  
plurality of VLANs and to one or more nodes via a VLAN-tagged communications  
link; the method comprising the steps of:

(a) a registration processing method comprising:

20 (i) receiving a plurality of multicast declaration messages specifying a first  
multicast group identification, wherein the multicast declaration messages  
originate from multicast group members associated with the plurality of  
VLANs;

(ii) registering each of the plurality of multicast group members from which the  
25 multicast declaration messages originated; and

(iii) forwarding only the first multicast declaration message of the plurality of  
multicast declaration messages to an upstream router;

(b) a multicast stream processing method comprising:

30 (i) receiving a multicast stream having the first multicast group identification  
from a multicast group member associated with a first VLAN of the  
plurality of VLANs;

(ii) switching the multicast stream towards substantially all of the one or more multicast group members, associated with the first VLAN, that are registered to receive the multicast stream; and

5 (iii) distributing the multicast stream towards substantially all of the one or more multicast group members, associated with the one or more VLANs outside of the first VLAN, that are registered to receive the multicast stream;

wherein the number of duplicate multicast streams that propagate across said one or more VLAN-tagged links is minimal.

10 16. The multicast optimization method in claim 14, wherein the step of distributing the multicast stream towards substantially all of the one or more multicast group members comprises the steps of:

- 15 (a) routing the multicast stream from the first VLAN to each of the one or more VLANs outside of the first VLAN associated with the one or more multicast group members; and
- (b) switching the multicast stream towards from the cross-VLAN switching device to substantially all the one or more multicast group members associated with the one or more VLANs outside of the first VLAN.

20 17. The multicast optimization method in claim 14, wherein the method further includes the step of switching substantially all unicast packets from the cross-VLAN switching device to each of the nodes specified in the respective unicast packet.

25 18. The multicast optimization method in claim 14, wherein the step of registering each of the plurality of multicast group members further comprises the step of recording multicast subscriptions in one or more VLAN/multicast group membership tables.

30 19. The multicast optimization method in claim 14, wherein the method further includes the step of de-registering a first multicast group member of the one or more multicast group members from the cross-VLAN switching device, wherein the subscription to the multicast stream is rescinded.

20. The multicast optimization method in claim 18, wherein the step of de-registering occurs in response to a leave message from a first multicast group member of the one or more multicast group members.

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21. The multicast optimization method in claim 19, wherein the leave message is an IGMP Leave message.

10 22. The multicast optimization method in claim 20, wherein the method further includes the step of forwarding only the last leave message of the plurality leave messages of the one or more multicast group members toward an upstream router.

15 23. A cross-VLAN switching device operatively coupled to a subnet including a second node; the switching device and node configured to support a plurality of VLANs including a first VLAN and a second VLAN, and VLAN tagging; the cross-VLAN switching device comprising:

- 20 (a) a management module comprising one or more VLAN/multicast group membership tables for registering multicast group membership subscriptions; and
- (b) a packet forwarding engine for:
- (i) switching unicast packets within each of the plurality of VLANs; and
- (ii) routing one or more multicast packets between the plurality of VLANs in accordance with the multicast group membership subscriptions of the one or more VLAN/multicast group membership tables;
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wherein transmission of one or more duplicative multicast packets across VLAN tag-aware communications links is minimal.

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24. A multicast optimization method for a packet-based network including a plurality of nodes interconnected by a plurality of links, and a multicast group, wherein the multicast group includes a first node belonging to a first VLAN and a second node belonging to a second VLAN, wherein the first VLAN and the second VLAN are different, the method comprising the steps of:
- (a) receiving at a third node a packet destined for the multicast group;
  - (b) transmitting the packet from the third node to the first node on a first path; and
  - (c) transmitting the packet from the third node to the second node on a second path,
- wherein the first path and the second path include a common VLAN-tagged link supporting the first VLAN and the second VLAN, and wherein the packet traverses the common VLAN tagged link once.